Corn-Based Ethanol: The Good, the Bad and the Ugly

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The wisdom of ethanol

- In 2008,

- 11 billion gallons of ethanol produced from corn
  - 3.9 bill bu corn (30-35 % of crop)
  - Equiv to 8 billion gallons of gas (70% energy)
  - 5.7 % of gasoline use (140 bill gallons/yr)
  - At least $5 bill subsidies to blenders ,etc
    - 51cents/gallon federal subsidy to blender
    - MN alone pays about $26 million/yr

The Good

- Profits to grain farmers
- Economic growth in rural communities
- Increased attention to agriculture as source of several amenities incl fuel
- Fostering innovative research on biology, chemistry
- Causing a rethink of landscapes

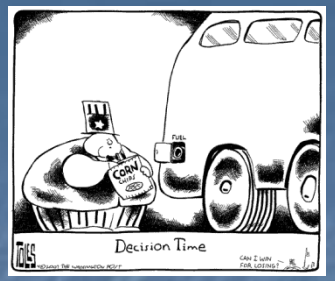
The Bad

- Built on a web of politics, corporate welfare and myths
- Propped up by subsidies, unrealistic rules and standards, tariffs
- Compromising politicians, academy, other leaders
- Putting agriculture at risk

Farmers should get the benefit

- However, farming costs also have skyrocketed
  - Fertilizer, 2-3X (because of high natural gas costs and demand elsewhere
  - Seeds $300/bushel
  - Fuel more than double
  - Land up double digits in 2007, now $5000 or more for an acre of good land in Midwest
  - Concern that agriculture heading for a dot-com bust

The Bad



- Unintended consequences
  - Decline in water quality (nitrate, chemicals, sediment
  - Increase in soil erosion by water and wind
  - Stress on water supplies
  - Loss of biodiversity
  - Loss of permanent grasslands, CRP
  - Increase in food and livestock feed costs (ethanol estimated to increase food costs 15-30%, swine and beef feeders under stress)

The Ugly

- Myths
  - Energy independence
  - Oil mostly from hostile Middle East
  - Renewable fuel
  - Lowers global warming by sequestering CO2
  - Large number of jobs associated with ethanol
  - We can grow enough corn

Biofuels and food prices

- Corn clearly displacing other food crops
- More corn into ethanol, less for animal food and exports, increasing prices in US and world wide, estimated 15-30%
- Biofuel craze world wide, e.g., cassava being converted to ethanol
- Food riots are destabilizing nations

The Unknown

- Weather –floods and droughts
- Climate change
- Corn diseases and pathogens
- Ethanol overproduction
- Corn prices get too high
- Gasoline prices drop
- Changes in subsidies and tariffs
- Public antipathy or hostility

How it all began enter HFCS

- In 1957, conversion of corn syrups to fructose by enzymes
- High fructose corn syrup found to be as sweet as sugar at 55% HFCS-45% corn syrup (glucose) 42% HFCS good for baking
- Use of HFCS rapidly expanded beginning in 1975

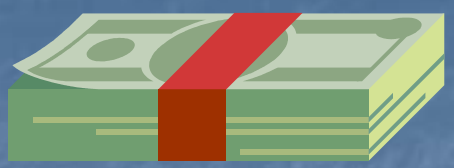
Major producer of HFCS

Born Worthington MN 1918
Retired ADM 1999
On trial for lysine price fixing in 1997, son ended up doing time.

Dwayne Andreas

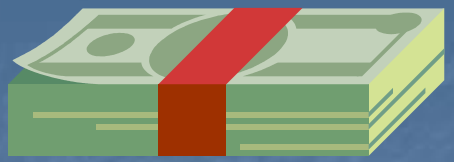
Spent millions to promote ethanol to presidential Campaigns and legislative PACS over the years

ADM is the largest single ethanol producer in the world



Power ethanol

- Ethanol fit well with wet milling process for producing HFCSA
- Andreas moved aggressively to promote ethanol as a clean automobile fuel, with big PACS and lobbying.
- Politicians included Robert Dole, Hubert Humphrey Carter, Reagan, Bush 1, Clinton, Daschle (now lobbies for ethanol industry).
- Established the Renewable Fuels Association and aided lobbying by the National Corn Growers.



Power ethanol

- Favorable legislation started with Carter, sponsored by Dole.
- "incentives" (really subsidies)
- Tax breaks
- Renewable Fuel Standards (now binding)
  - MN wants to go to 20% ethanol in all gasoline
- Promotion adds, etc.
- Research/development funding (Federal, Private and University)


WASHINGTON D.C.
SUPERMARKET TO ARCHER-DANIELS-MIDLAND
AISLE B
AISLE C
AISLE D
Etta Hume/Fort Worth Star-Tribune

Ethanol and energy balance

- On field scale, ethanol ranks from equal energy out to energy in, to a positive 1.3
- Irrigated corn has a much lower ratio
- High eo/ei ratio requires high corn yields
- Must have fossil fuels to produce ethanol
- LCA's showing land displacement greatly increases CO2 output, requiring years to break even

Renewable Fuel Standards (RFS)

Corn starch based ethanol, 2006 through 2022

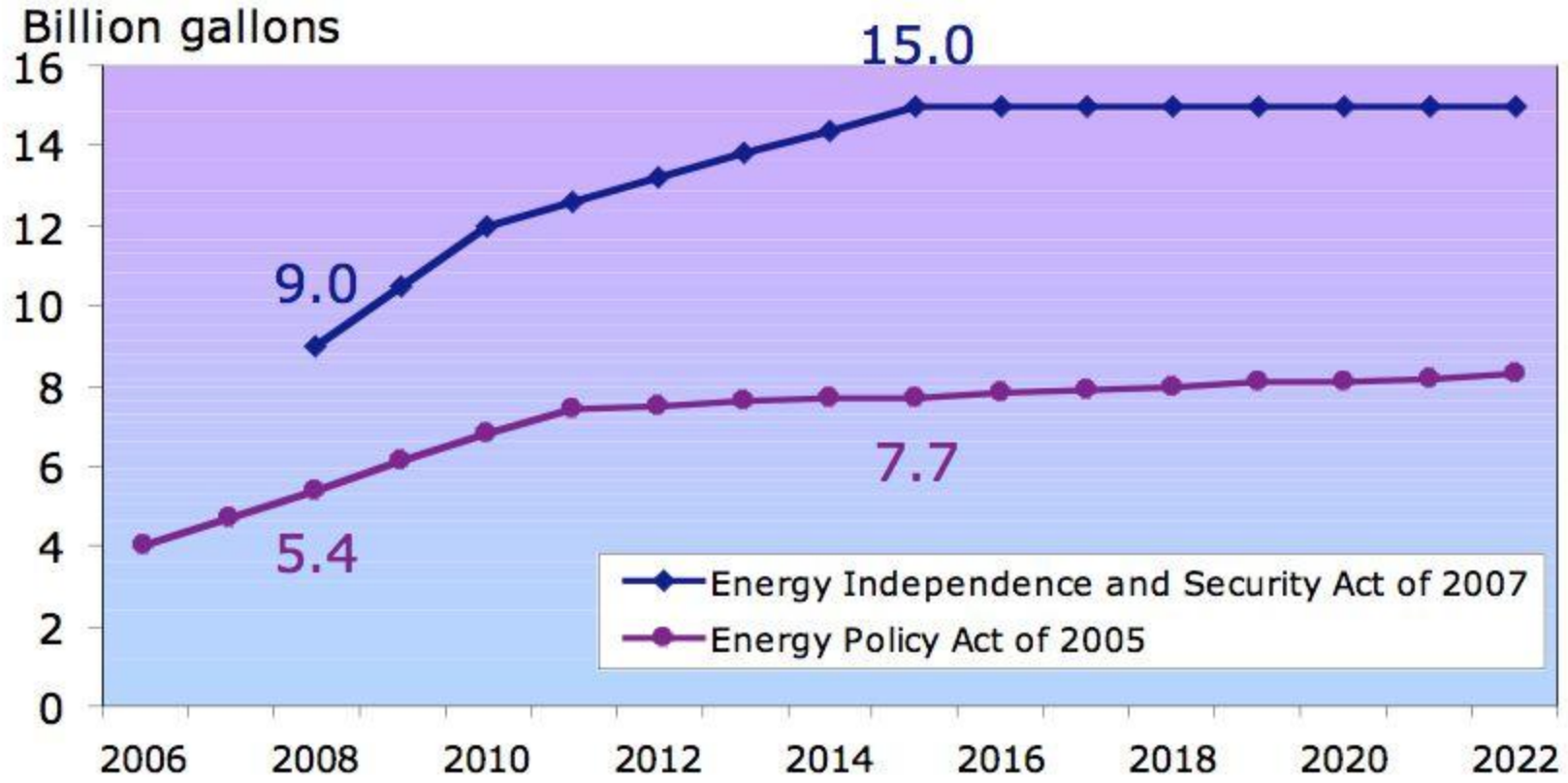
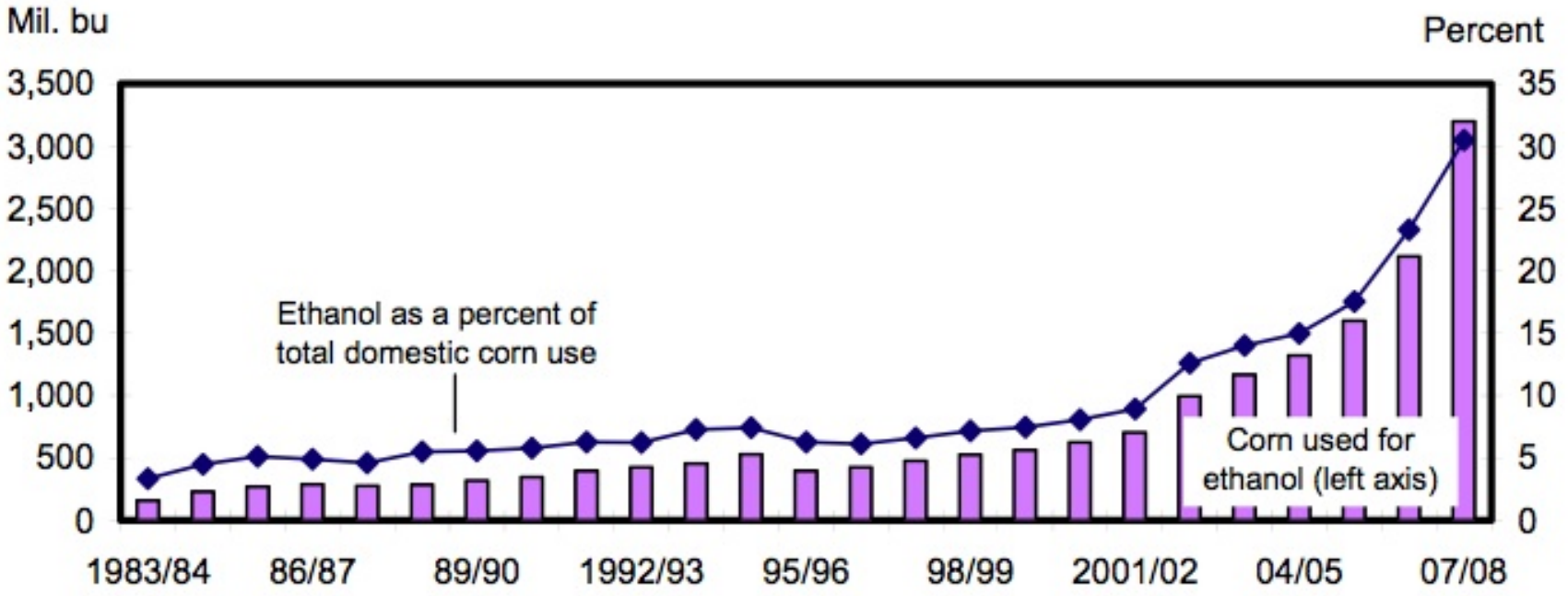


Figure 1

Record ethanol production drives domestic corn use



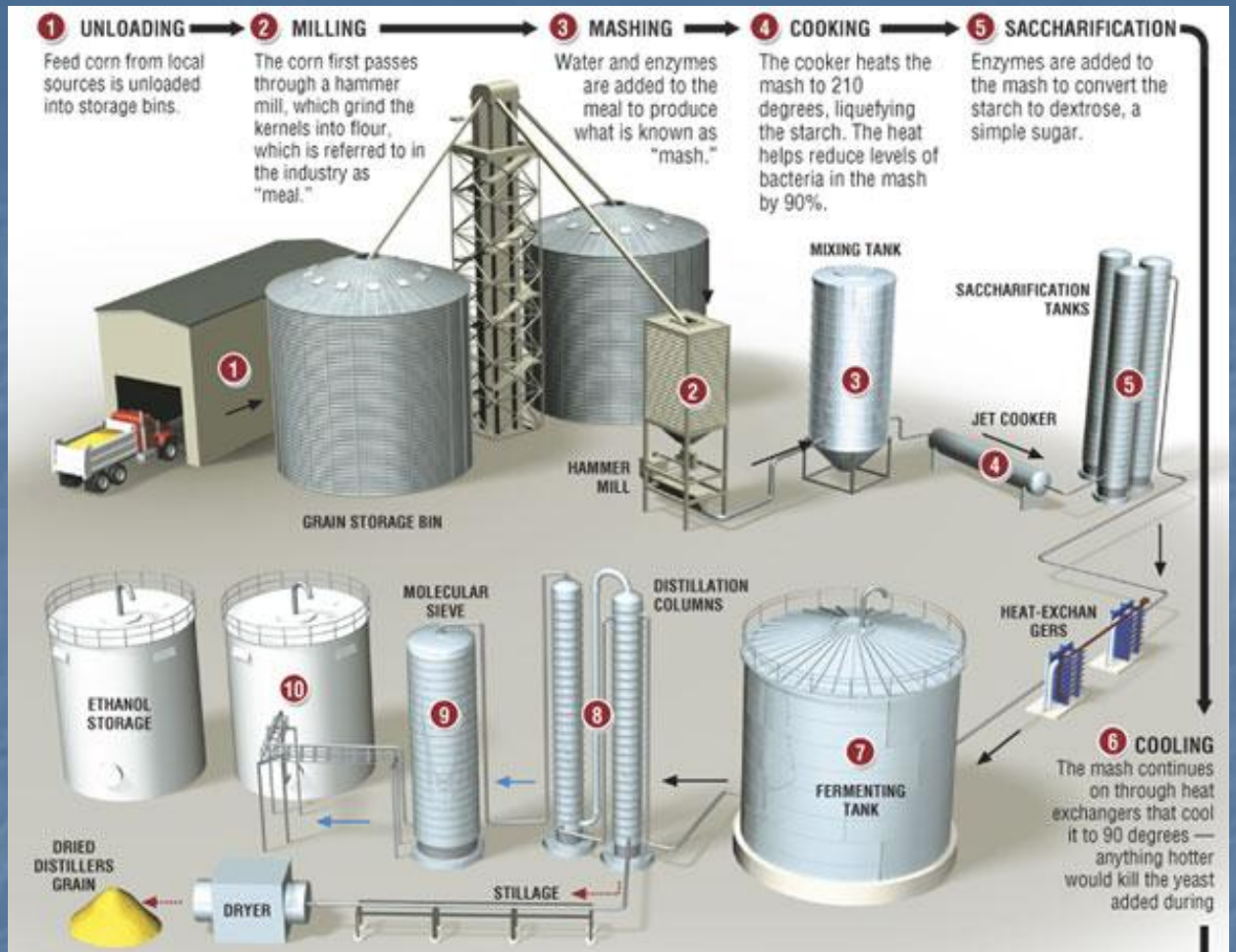
Source: USDA, World Agricultural Outlook Board, *WASDE*.

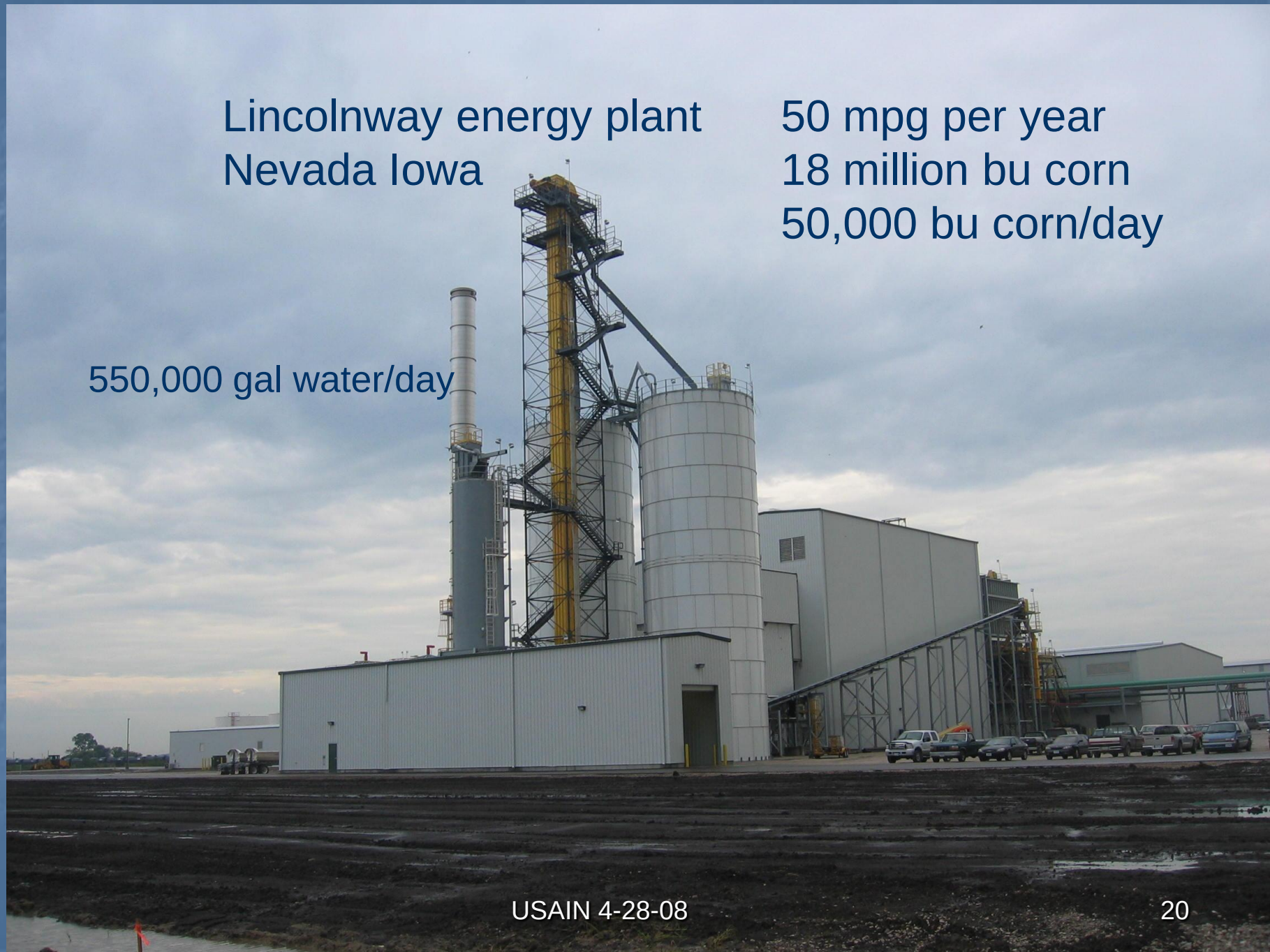
5.5 bill bu corn required to meet 2015 RFS, around 50% of crop

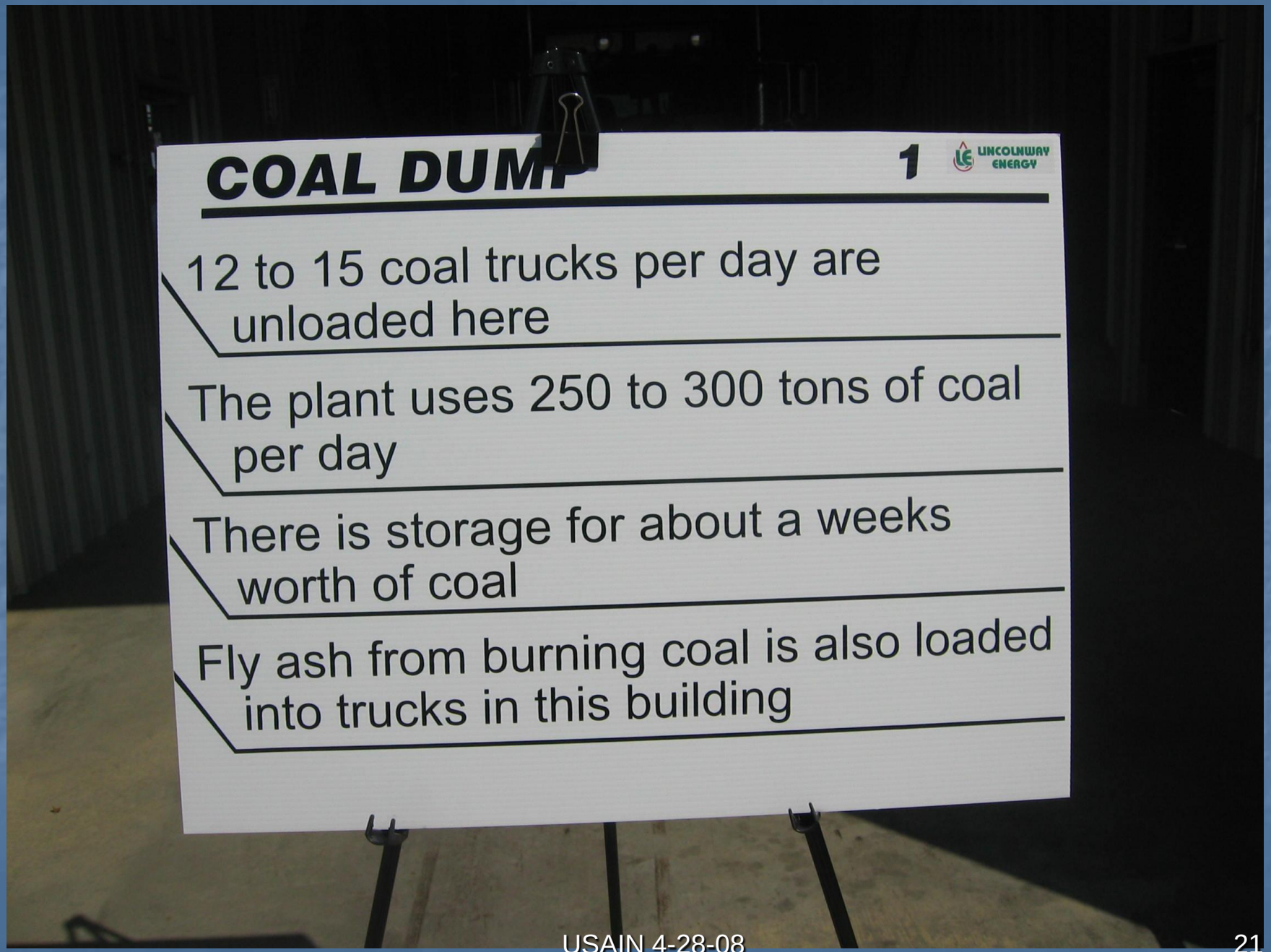
Big Oil Lobbying, 2005

Oil Company	Amount Spent
ChevronTexaco	$8,550,000
ExxonMobil	$7,140,000
ConocoPhillips	$5,098,084
Marathon	$4,290,000
BP	$2,880,000
Occidental	$2,042,177
Shell	$1,478,831
Ashland	$904,000
Sunoco	$540,000
Anadarko	$250,000
TOTAL	$33,173,092

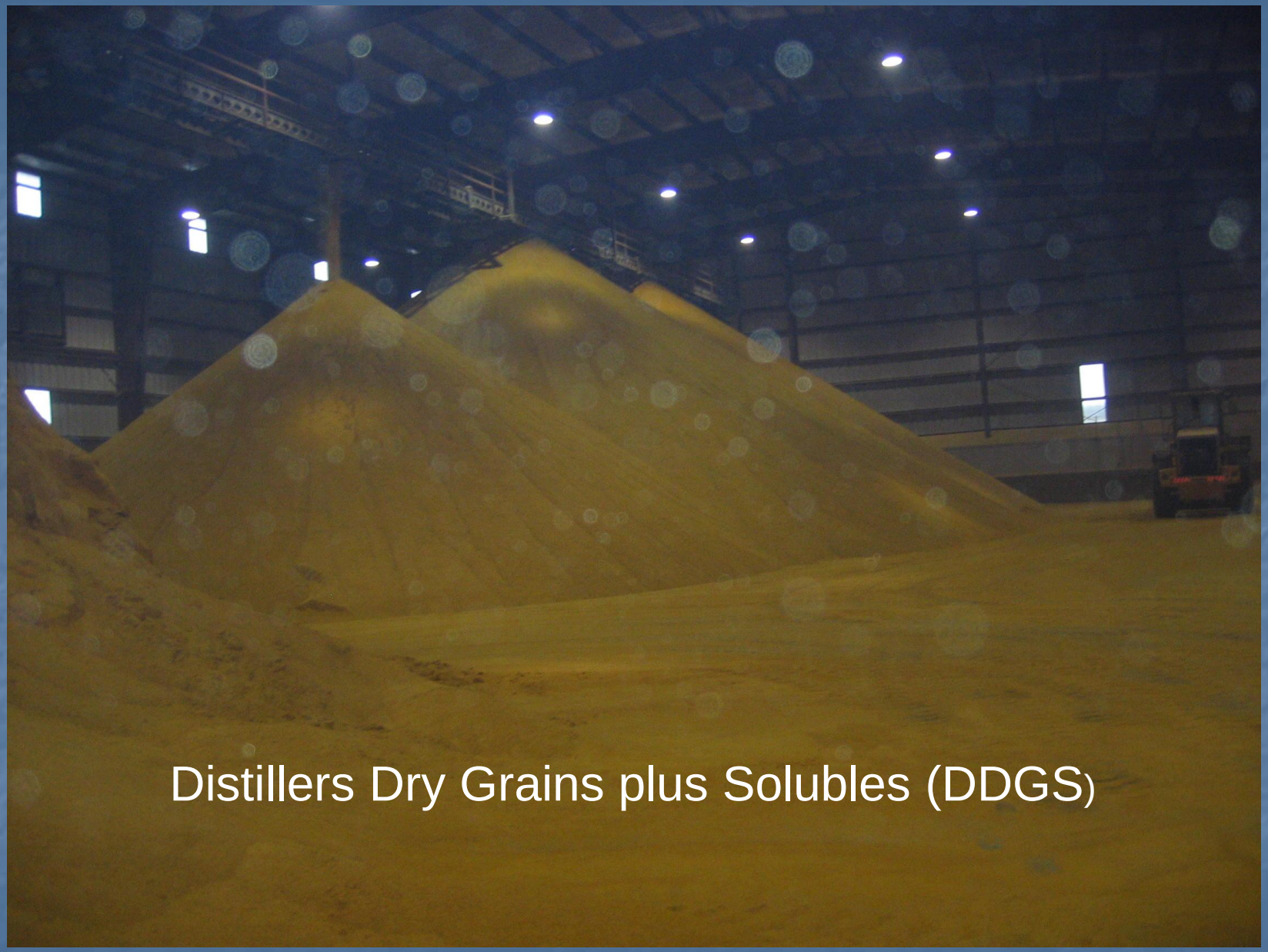
In the 1966 election cycle, ADM contributed $747,000, in 1992, $1.7 million


1 UNLOADING
Feed corn from local sources is unloaded into storage bins.
2 MILLING
The corn first passes through a hammer mill, which grind the kernels into flour, which is referred to in the industry as "meal."
3 MASHING
Water and enzymes are added to the meal to produce what is known as "mash."
4 COOKING
The cooker heats the mash to 210 degrees, liquefying the starch. The heat helps reduce levels of bacteria in the mash by 90%.
5 SACCHARIFICATION
Enzymes are added to the mash to convert the starch to dextrose, a simple sugar.
GRAIN STORAGE BIN
HAMMER MILL
MIXING TANK
JET COOKER
SACCHARIFICATION TANKS
HEAT-EXCHANGERS
6 COOLING
The mash continues on through heat exchangers that cool it to 90 degrees — anything hotter would kill the yeast added during
7 FERMENTING TANK
8 DISTILLATION COLUMNS
9 MOLECULAR SIEVE
10 ETHANOL STORAGE
DRIED DISTILLERS GRAIN
DRYER
STILLAGE
7 FERMENTATION
Yeast is added to the mash to ferment the sugars. During this process, the yeast eat the sugars, and in the process produce heat, ethanol and carbon dioxide. It takes 48 hours for the mash to make it through the fermentation process.
8 DISTILLATION
After fermentation, the mash is called beer. Beer is made up of 15% alcohol and 85% non-fermentable solids and is ready for distillation. During distillation the beer is continuously pumped through a multi-column system that separates the alcohol and stillage. The alcohol moves on to dehydration. The stillage is
distillers grains.
9 DEHYDRATION
The alcohol circulates through a molecular sieve to capture the last bit of water. At the end of this process, the ethanol is pure at 200 proof. A small bit of gasoline is added to make it unfit for human consumption and avoid taxes levied on alcohol.
10 STORAGE
Finally, the ethanol is pumped into storage tanks. It is then ready for shipment to gasoline terminals or retailers.
11 STILLAGE
The stillage is sent through a centrifuge that separates the coarse grain from the solubles. The solubles are then concentrated to about 30% solids by evaporation, resulting in Condensed Distillers Solubles (CDS) or "syrup." The coarse grain and the syrup are then dried together to produce dried
grains with solubles (DDGS), a high quality, nutritious livestock feed.


Lincolnway energy plant
Nevada Iowa
50 mpg per year
18 million bu corn
50,000 bu corn/day
550,000 gal water/day


COAL DUMP
1
LINCOLNWAY ENERGY
12 to 15 coal trucks per day are unloaded here
The plant uses 250 to 300 tons of coal per day
There is storage for about a weeks worth of coal
Fly ash from burning coal is also loaded into trucks in this building

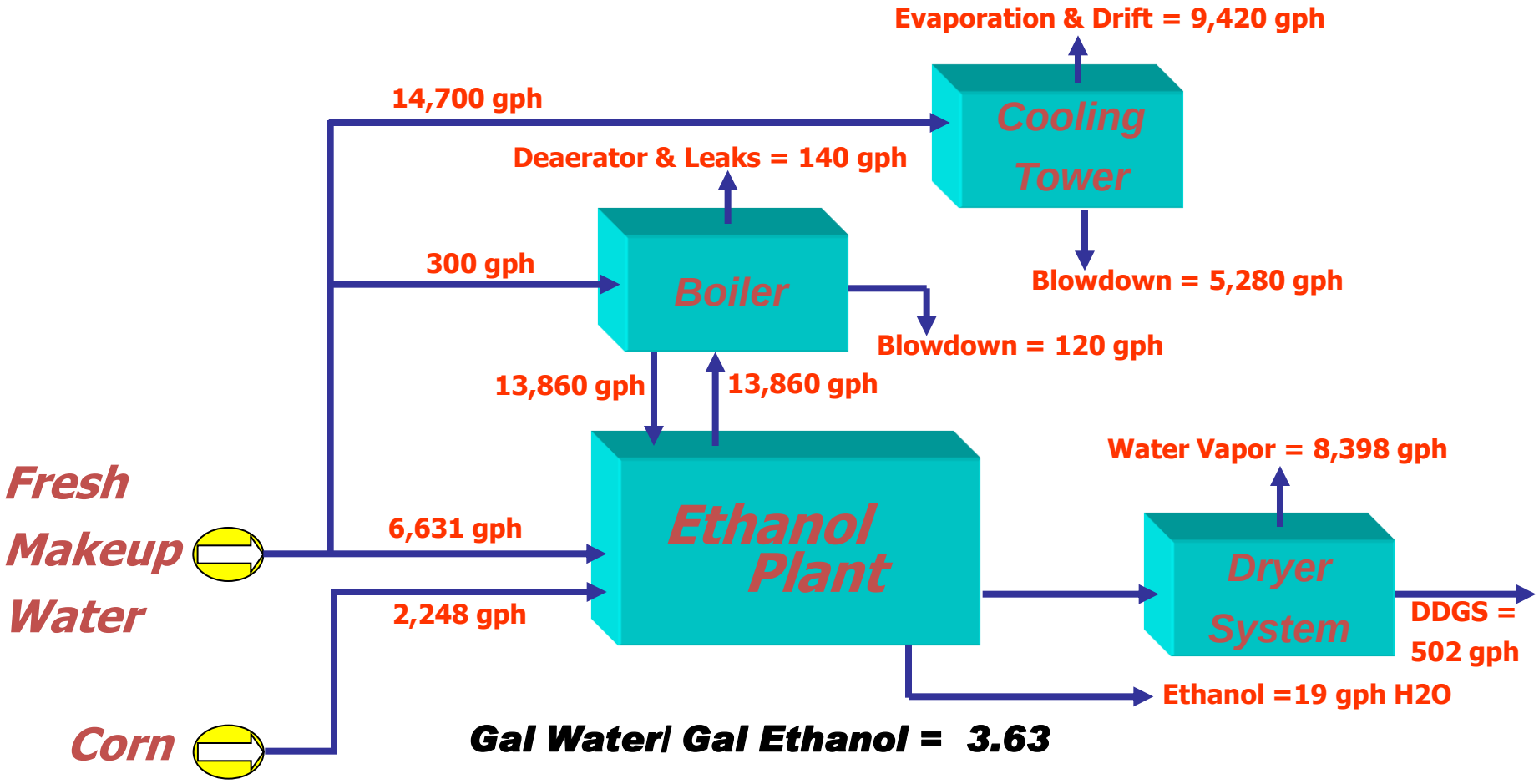
Ethanol tank cars, now in short supply


Distillers Dry Grains plus Solubles (DDGS)

It takes water to produce ethanol

- 4 gallons water per gallon of ethanol
  - 50 mgpy plant needs 200 mpg water, 550,000 g water per day
- Groundwater preferred
- Siting issues with several communities
- Could limit industry expansion

Overall Water Balance

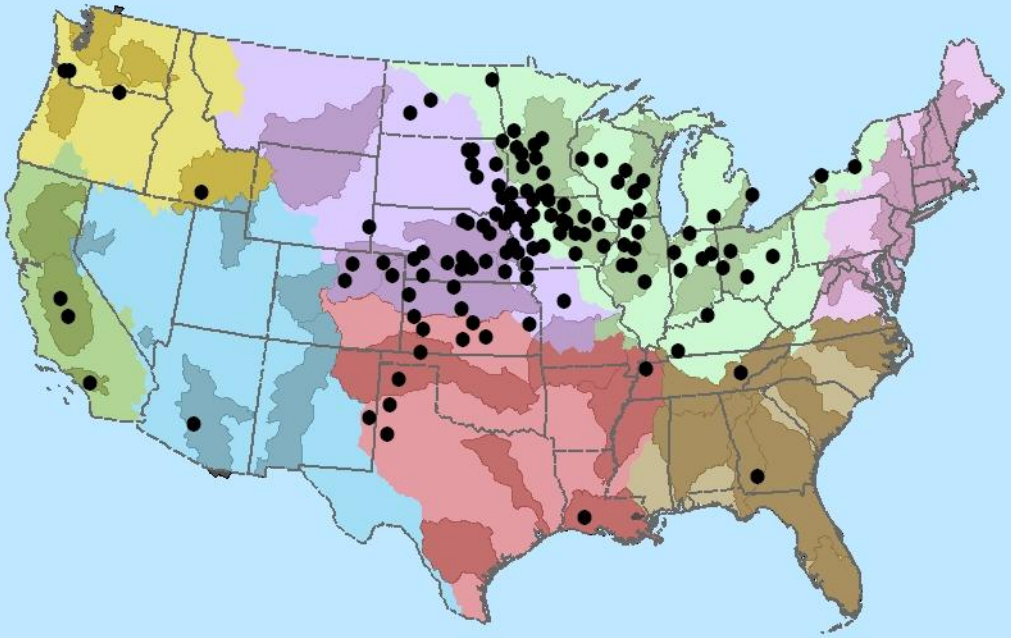


Basis: 50 mmgpy Typical Corn-Based Dry Mill ethanol Plant

Biofuels and air quality, global warming

- Ethanol shown to increase smog
- Ethanol increases cancerous benzene emissions
- All current biofuels increase carbon dioxide emission relative to gasoline
- Corn culture source of nitrous oxide, methane, greenhouse gases

Major River Basins of the Nation



New England and Mid-Atlantic
South Atlantic-Gulf and Tennesee
Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy
Missouri
Lower Mississippi, Arkansas-White-Red, and Texas-Gulf
Rio Grande, Colorado, and Great Basin
Pacific Northwest
California

● City with existing or proposed ethanol plant (June 1, 2007)

Water Quality

- Nitrate leaching to Gulf of Mexico
  - Conversion of CRP to corn and more continuous corn will markedly increase N fertilizer use.

Biofuels-worldwide

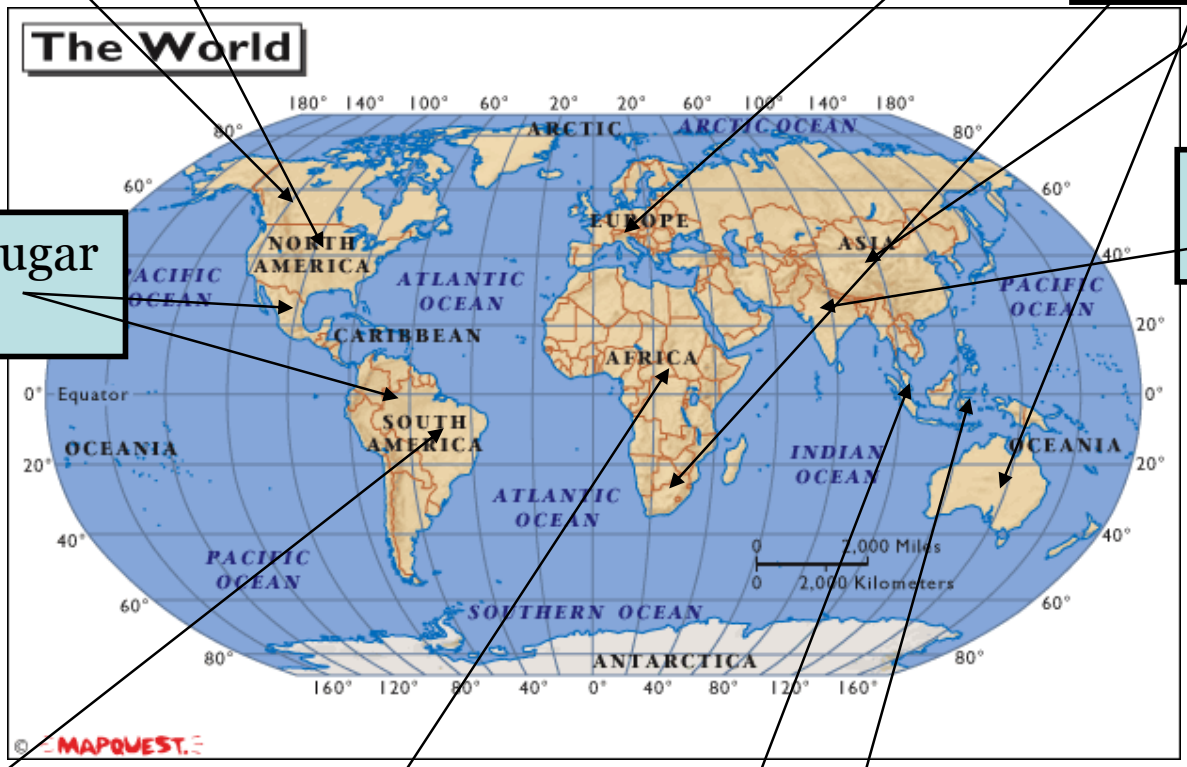
Ethanol-corn, biodiesel-soy

Biodiesel-oilseeds

Ethanol-corn

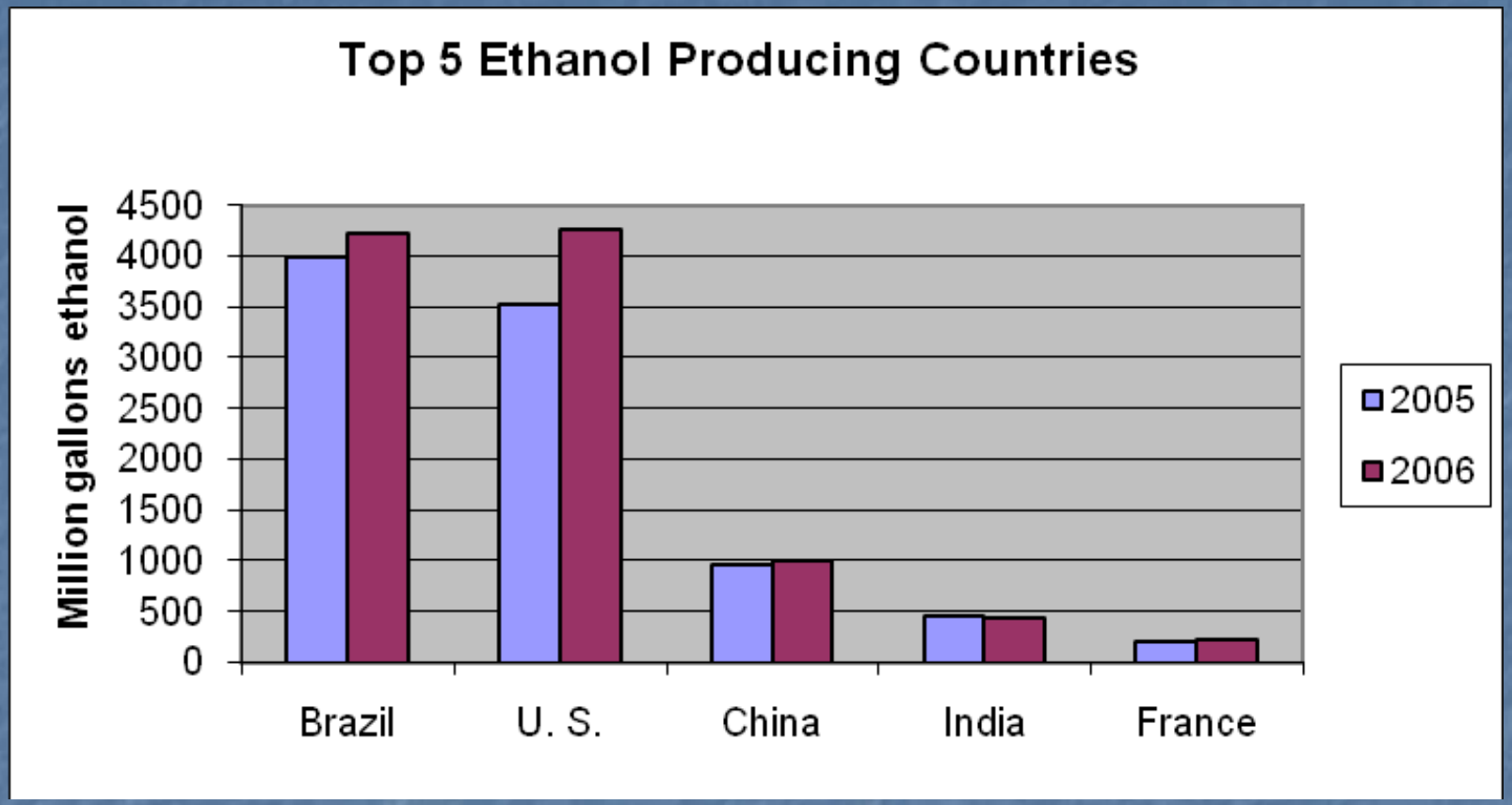
Ethanol, biodiesel

Ethanol-sugar cane



Biodiesel-palm

Ethanol-sugarcane
Biodiesel-soy, palm, cassava


Top 5 Ethanol Producing Countries
Million gallons ethanol
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Brazil
U. S.
China
India
France
2005
2006

Ethics of biofuels

Food vs Fuel

- Land use
- Free vs fair trade
- Labor
- Environmental Justice
- Food cost and availability

Joe Klein: How Al Gore Could Save The Democrats

Hillary Clinton On Why She Won't Quit

R.E.M. Rises from The Dead

TIME

The Clean Energy Myth

BY MICHAEL GRUNWALD

Politicians and Big Business are pushing biofuels like corn-based ethanol as alternatives to oil. All they're really doing is driving up food prices and making global warming worse—and you're paying for it

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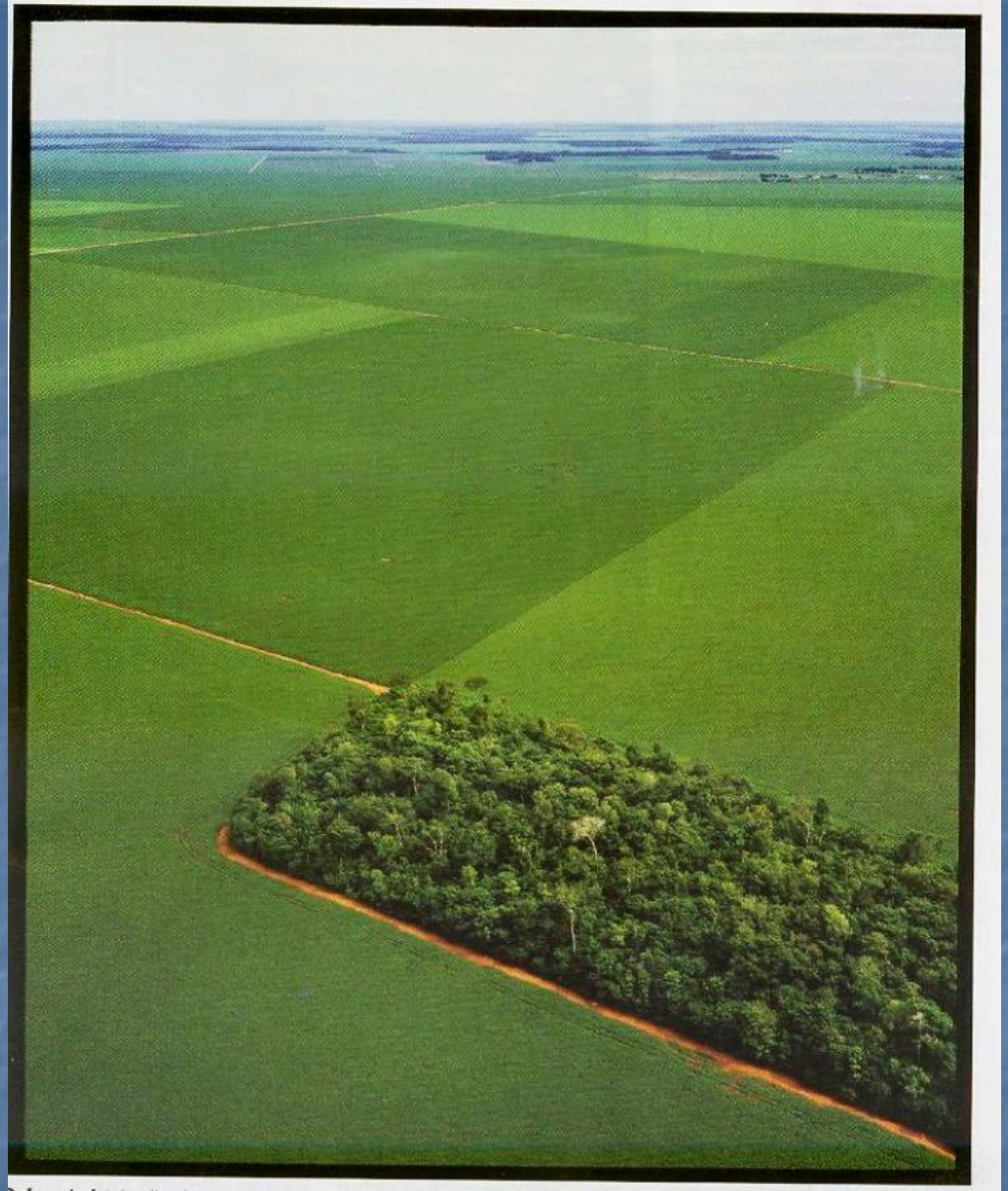
Marion 3rd 2008

ENVIRONMENT

The Clean Energy Scam.

Hyped as an eco-friendly fuel, ethanol increases global warming, destroys forests and inflates food prices. So why are we subsidizing it?



Deforested *A tiny slice of preserved transitional rain forest is surrounded by acres of soybean crops in Brazil's Mato Grosso state. Used to make biofuels, the soybeans are boosting the local economy at the Amazon's expense*

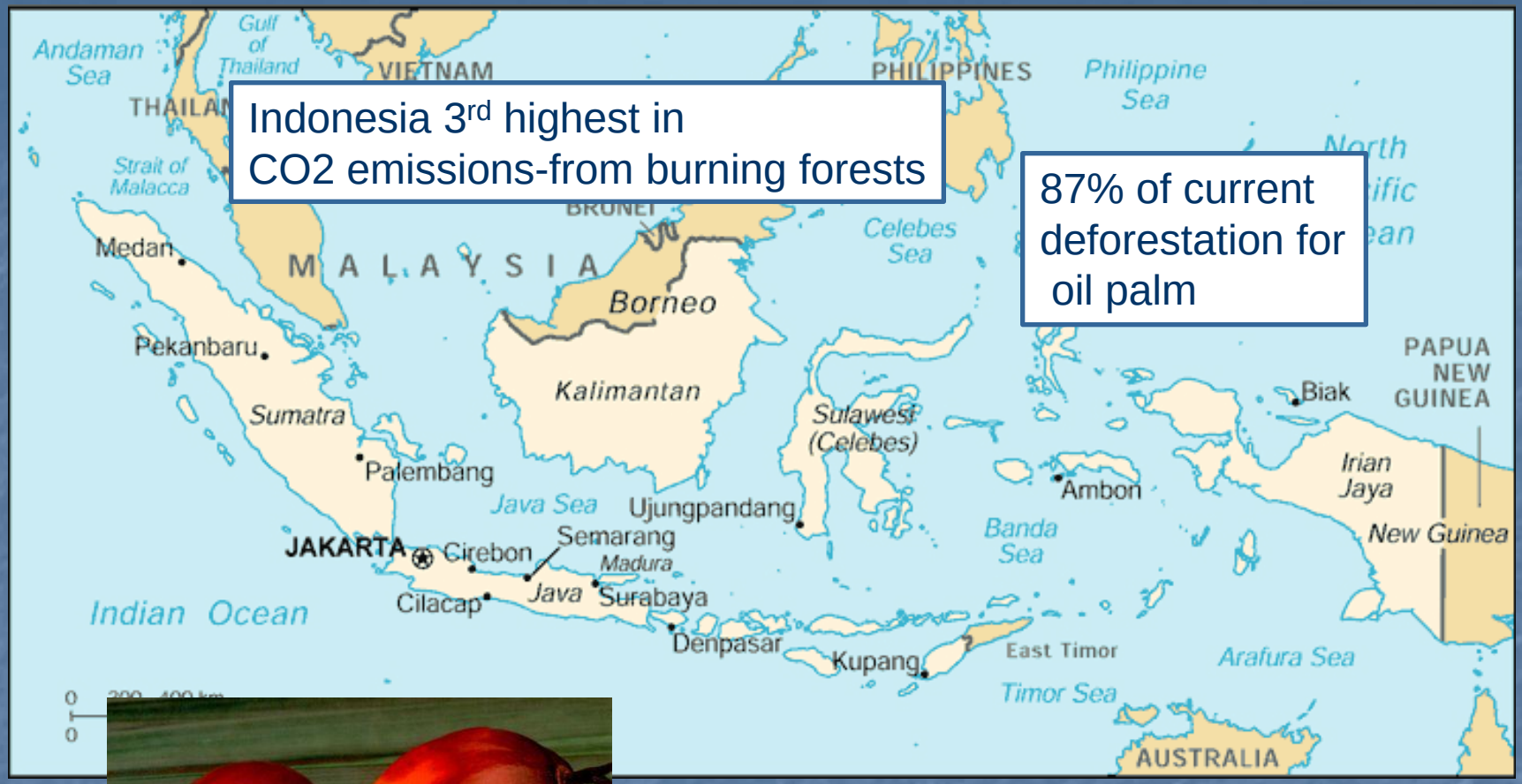
365
Days one person could be fed on the corn needed to fill an ethanol-fueled SUV

$100 billion
Estimated size of 2010 biofuel market

750,000
Acres of Brazilian rain forest lost in the last six months of 2007 (equal to the area of Rhode Island)

Indonesia 3rd highest in CO2 emissions-from burning forests

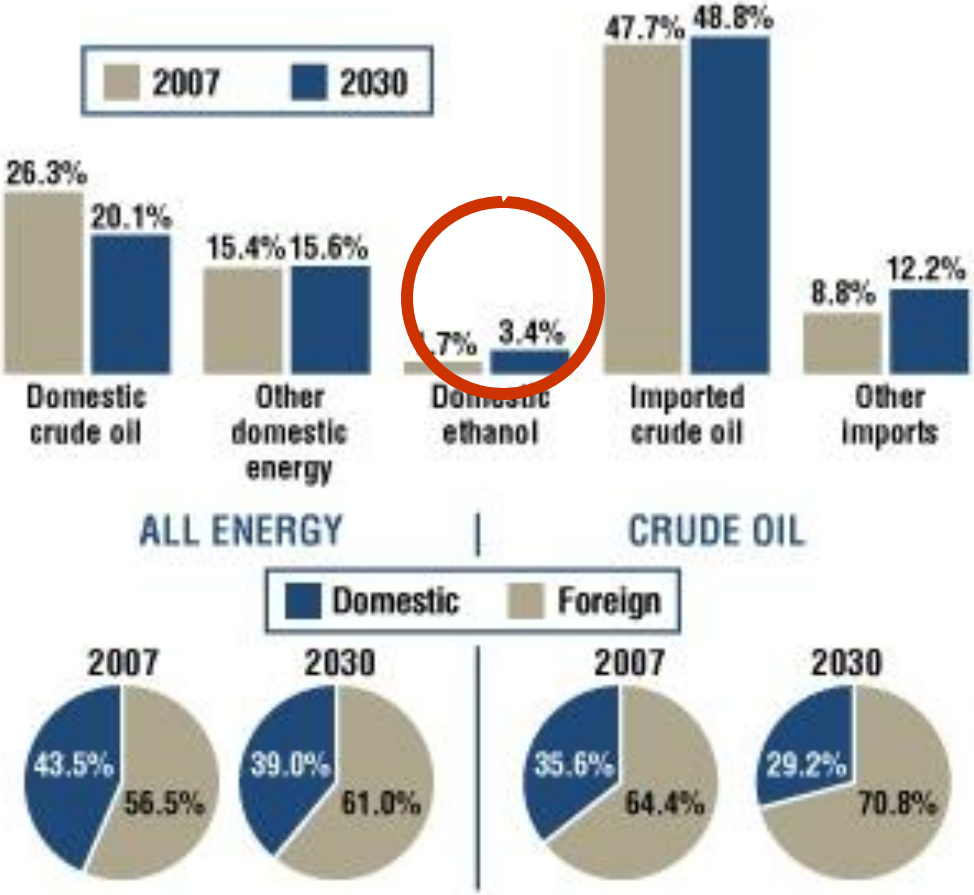
87% of current deforestation for oil palm



Indonesia and Malaysia

Where our energy comes from

Despite efforts to decrease the U.S. reliance on foreign energy sources, Department of Energy projections forecast a growing dependency of imported crude oil and other imported energy. A look at projected energy supplies:



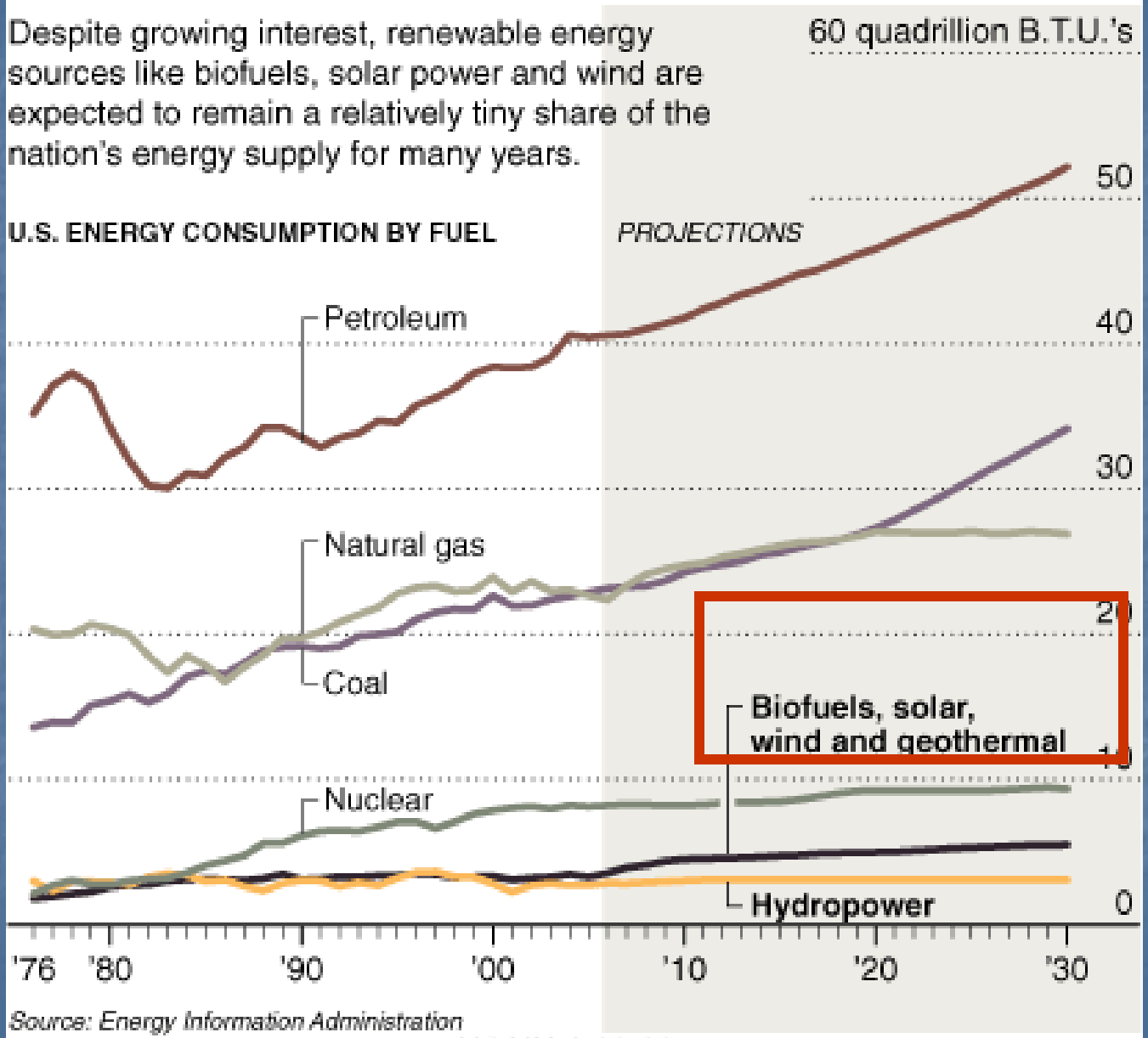
Notes: Other domestic energy includes energy from natural gas and coal. Other imports include energy from ethanol in addition to others. Import figures represent the net imports (gross imports minus any exports in that category). Numbers may not add up to 100 percent due to rounding.

Source: Department of Energy proje[illegible]ent technology.

THE REGISTER

Addicted to Fossil Fuels

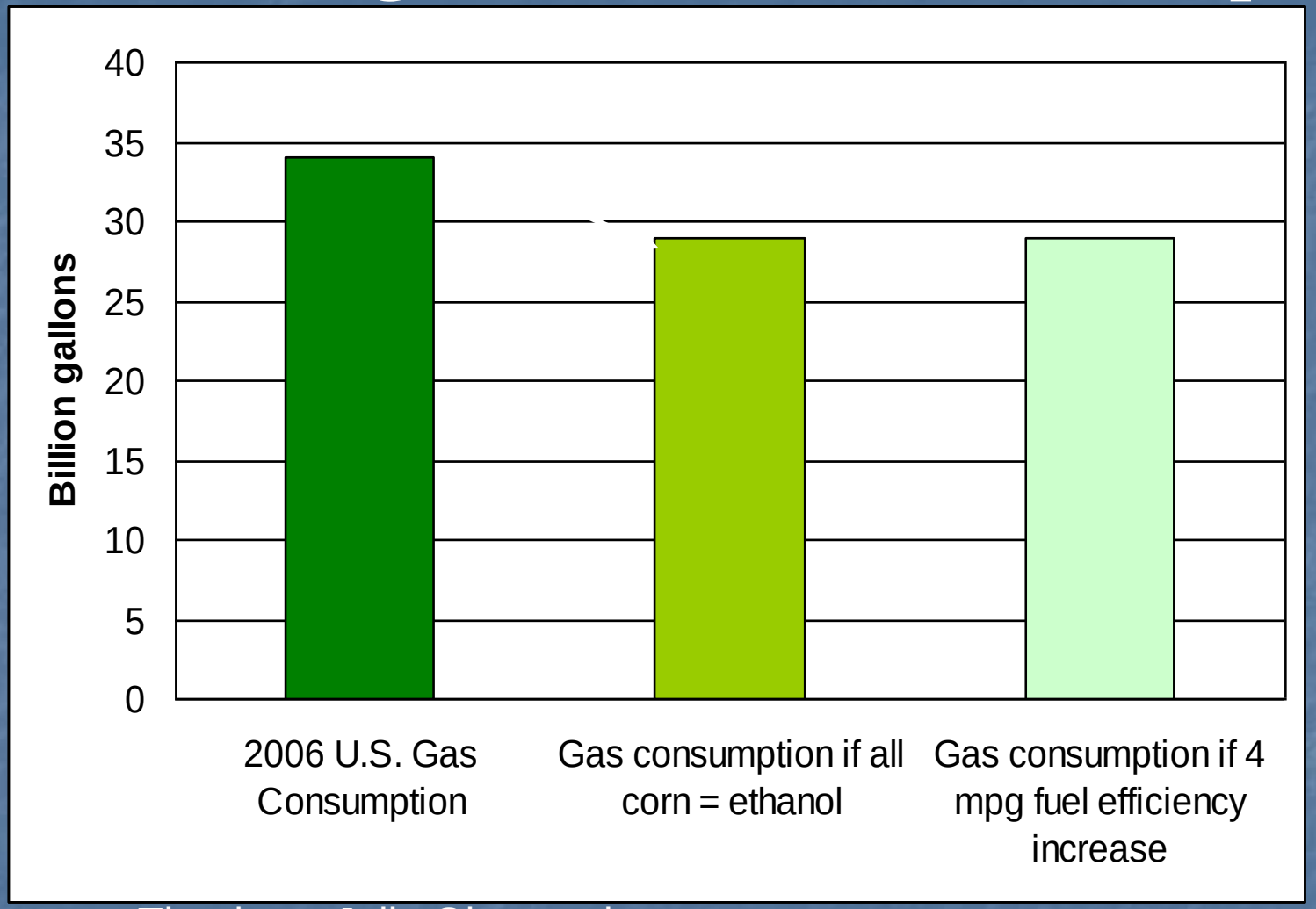
Despite growing interest, renewable energy sources like biofuels, solar power and wind are expected to remain a relatively tiny share of the nation's energy supply for many years.



Source: Energy Information Administration

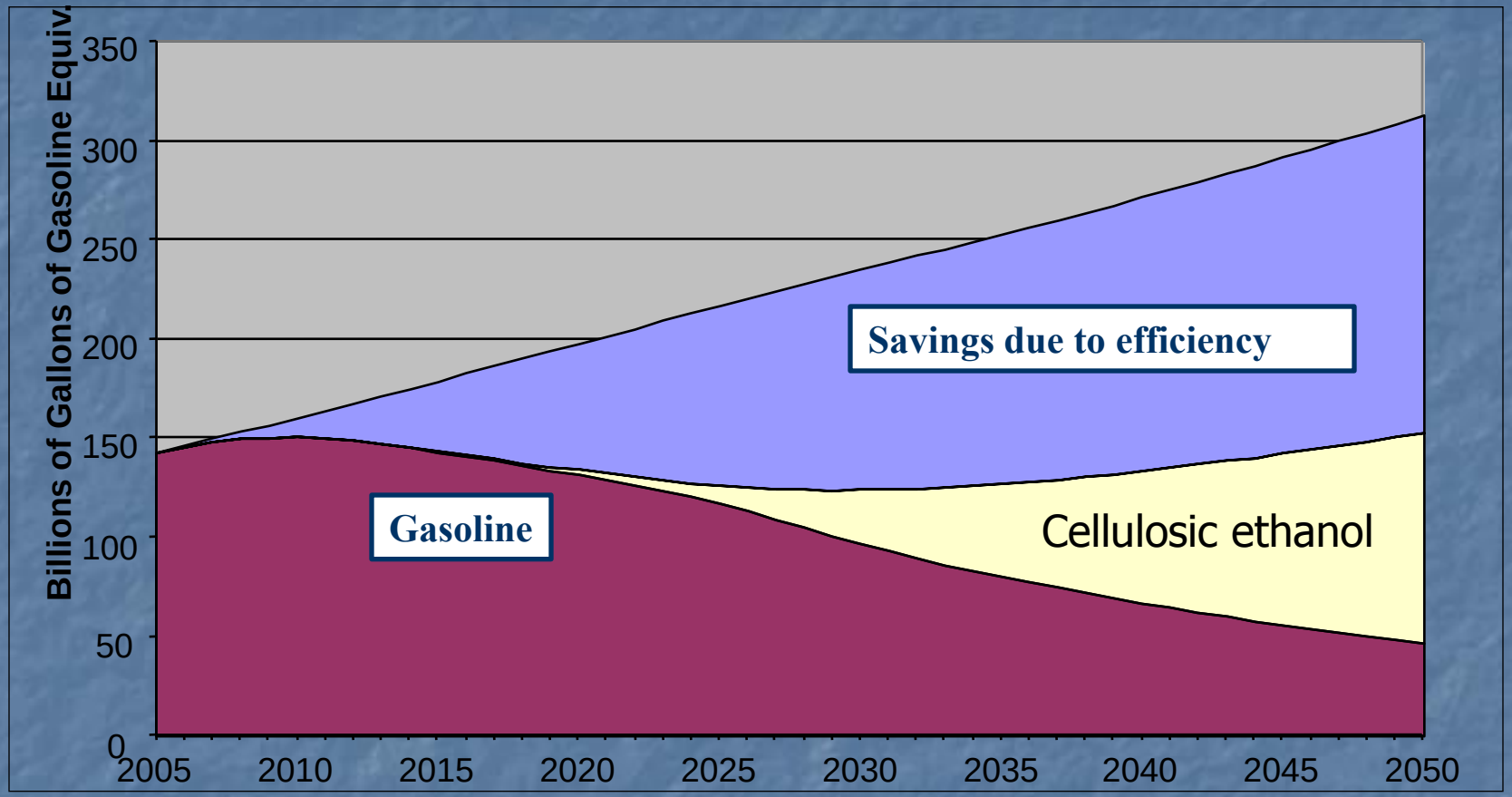
The New York Times

How much gasoline can ethanol replace?



Thanks to Julia Olmstead

An Evolving Vision for Long-Term Impact
Nathanael Greene, NRDC



Lee Lynd, 2006

Ethanol's future

- Probably stuck with ethanol for awhile
  - Proponents: land grants, DOE, USDA, venture capitalists, almost all politicians
- Cellulose offered as next generation
- Other technologies (syngas, butanol)
- Need more product mix
- Where is the academic community?
  - Some in Ag Econ speaking out, and Tillman's group at UM

Policy recommendations

- Phase out blenders credit over 5 years
- Remove tariff on Brazilian ethanol
- Let market place work
- Remove or considerably lower RFS (EU already is backing off)
- Use blenders credit money for research ($7.5 billion)


Thanks


Thank you


Thank You


Merci


Hvala


THANK YOU


THANK
YOU


Thank
You!
Grazie


Vielen
Dank


Thank You